

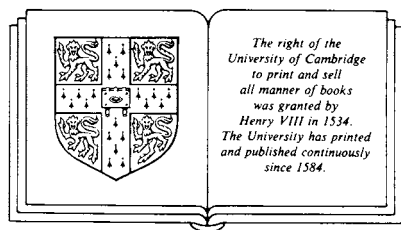
FROM KNOWLEDGE TO POWER

THE RISE OF THE SCIENCE EMPIRE IN FRANCE,

1860-1939

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INTRODUCTION

FROM DREAM TO DREAM IN LAYING THE FOUNDATIONS

L'histoire est un "roman vrai."

– Paul Veyne

IN his *Histoire de la civilisation en Europe* (Sorbonne lectures, 1828–30), François Guizot showed without difficulty that French civilization was the truest representative of European culture. That this judgment was a truism for cultured men of the day was evident in John Stuart Mill's ready assent that only a clod could not know that "the history of civilization in France *is* that of civilization in Europe." What was the nature of this civilization that enthralled the European mind for at least two centuries? The superb German survey entitled *The Civilization of France* (1930) by Ernst Curtius makes it mainly a matter of literary culture: "Literature plays a far larger part in the cultural and national consciousness of France than it does in that of any other nation." Victor Hugo summed it up: "Literature is civilization." Curtius argued that "in France literature fulfills the function which among us [Germans] is divided between philosophy, science, poetry and music." So even Cartesianism, "the most important factor in the intellectual history of France," was distilled into the literary cliché of *clarté française*. France's intellectual hegemony in Europe was facilitated by the cultural universality of its language, characterized by "logic, lucidity, brilliance, naturalness, and taste." This leaves little room for the cult of Isis, widely touted elsewhere as the goddess to whom we must pay tribute for our modernity. Curtius makes only a few remarks concerning the ideological value of science in France as a source of liberation from "the authority of dogma, society and custom."¹

Like most fascinating generalizations, that of Curtius on the role of science in French civilization has just enough truth in it to be quite misleading. In spite of the importance of the medieval Sorbonne as a center of scholastic criticism providing a point of origin for the scientific theories of the sixteenth and seventeenth centuries, by the time of the Renaissance the university was so moribund that the monarchy permitted humanists to lecture outside the university – this was the "founding" of the Collège de France. This was also the beginning of the classic French policy of creating new institutions rather than fighting the battle of reforming old ones. François Furet assumes that a law is in operation: "The history of French higher education obeys a law of

peripheral development.”² It is true that the institutionalization of the Académie française (1635) established a literary connection with the state, but the sciences were not far behind with the founding of the Académie des sciences (1666). In the seventeenth century, Paris was an international scientific center, although many of the savants were foreign. Because the government was interested in good administration and concerned with defense, the eighteenth century was an especially creative period in the founding of higher scientific-technical-engineering schools: the Ecole des ponts et chaussées (1715), the Ecole royale du génie (1748), the Ecole des mines (1783), and the Ecole polytechnique (1794). From about 1750 to 1840 France enjoyed scientific preeminence in Europe. Later in the nineteenth century, the rise of German and British scientific research had the comparative effect of reducing France to *one* of the centers of science in the Western world.

France remained a leader in scientific teaching and research. Few countries had such a galaxy of comparable institutions: the Sorbonne, the Ecole normale supérieure, the Collège de France, the Muséum d'histoire naturelle, the Polytechnique, the Observatoire, and a whole gamut of technical institutions. The significant institutional creations of the late nineteenth century were the Ecole pratique des hautes études (1868), the Institut Pasteur (1888), the Ecole supérieure de physique et chimie industrielles (1883), the Ecole supérieure d'électricité (1894), the laboratories of marine biology, and a few good provincial faculties of science. By the time of the Great War, state-supported or subsidized institutions were doing a respectable job in scientific education and research. Research related to industry became increasingly important, especially in provincial faculties of science. Even after the devastation wrought by the two world wars, France was able to develop a new structure of scientific education and research; that it could do so was in some measure a result of the scientific and technological potential built up over the preceding century.

The French budget plan for 1983 included 52.2 billion francs for research and industry, an increase of 35.8 percent over 1982.³ There was a clear priority given to scientific research, technological development, industrial restructuring, and the development of national energy sources. The establishment of a Ministry of Research and Industry by the Socialists shows their commitment to the belief that basic research is closely linked to industrial prowess. The Socialist decision to build the much-debated Museum of Science and Technology at La Villette, a temple for the new religion of science, shows both the government's desire to make the public aware of the transforming power of science and technology and Socialism's devotion to its historical heritage.⁴ While recently praising Jack Lang's notorious verbal

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fandango in Mexico, François Gros harkened back to the seminal period of French scientism in the nineteenth century, a period when men knew the liberating virtues of science. Socialist action is the most recent of a series of intensive efforts and financial investments by government and industry since the Second Empire. Of course the big science that came into being after World War II takes us in many ways into a different world. By the 1930s big science may not have begun, but the epitaph of little science had already been written.

While pushing the growth of science many scientists innocently came to know sin, but it does not seem that the pursuit of an elusive power led to a weakening of the human lust for knowledge, science's primal pulse. Knowledge and power are really inseparable. The history of modern science makes it clear that knowledge can be achieved only through the medium of some type of power, by the close alliance of scientists with the state while forging or maintaining their own cognitive and disciplinary identities. In his *Science and Polity in France at the End of the Old Regime*, Charles Gillispie has intrigued us with the intersections between government and science.⁵ In the nineteenth and twentieth centuries these intersections progressed to the point of interface or even intussusception. My account of this development in France certainly recognizes the importance of "the integration of science into history through the medium of events and institutions," but it does not claim to reject "configurations of ideas or culture." Perhaps this is my heretical homage to *The Edge of Objectivity*, still our best *Essay in the History of Scientific Ideas*.⁶

A major theme of this work is the astounding growth of university science in France from the Second Empire (1860s) to the period of incipient disintegration of the Third Republic (1930s). Outside the auto-titillating world of literary criticism, context is still viewed as of some importance in understanding the discourse. French scientific growth makes sense only within an elucidation of the distinctive nature of French economic, political, and social life. The growth of science was stimulated by a number of essential tensions: Parisian versus provincial priorities in scientific development, the eternal university problems of a division of resources between teaching and research, the hoary distinction between pure and applied science, science as objective icon versus science as ideological fetish, and prolific if sometimes fruitless quarrels between scientists over the direction of science, its methods, and the partition of the spoils of its victories. "Le sens de l'histoire appelle tout d'abord son contresens."⁷

It is now commonplace to argue that "conceptions of science are shown to be sustained by particular social and political contexts."⁸ This seems a reasonable generalization about the early years of the Third Republic, when,

as George Weisz has shown with Benedictine fidelity to the evidence, politicians and power brokers took educational reform seriously, with a keen interest in science, assuming that reform "was indispensable socially and politically."⁹ Unfortunately, this enlightening dogma must immediately be restricted to modest scope by the frank admission that little is known about the class basis of the Third Republic; class is not a very useful category of analysis in this case. Still, there are a certain number of tags and ideas that have become part of linguistic usage in the historical world, and little harm is done in using them with the realization that their explanatory power is limited, much like using an equation to "explain" gravity. In the analysis of local situations the precision of the data and the micro-nature of the problem sometimes justify a relaxation of the moral and critical scruples that are essential in the high-level generalizations necessary to achieve Mandarin status in theology and the social sciences.

A naïve epistemologist might be forgiven for believing that there is more certainty in economics than in social theory. It does seem that there is at least less confusion in economic retrodiction than in economic prediction, but even in retrodicting the historian is faced with an embarrassingly rich choice of historical models of growth. Among the better known of these clever concoctions are the Rostow model of "the airborne economy," the Gerschenkron model of "the deprived economy," and the Parsonian system with a modified version available in Aron's model, both of which are entrepreneurial or managerial hypotheses. "The battered and tired French economy of the nineteenth century" is a "test-bed for many of the historical models of economic growth." Although Clive Trebilcock leans more to a pessimistic view of French growth, accepting the steady growth theory of recent economic historians but limiting it with the slower pace of their honorable ancestors, he reluctantly concludes that "Spengler was wise to set aside the so-called objective factors limiting French growth (the limited demographic and capital resources of France), to replace the coal with soul explanations: French value patterns, French tastes, the heterogeneous nature of France's cultural heritage." Economics clearly comes under the empire of Derrida's deconstructionist axioms: "Everything can be given at least two equally cogent explanations; in the temporal process of thinking about anything, one explanation collapses into its contrary."¹⁰ It will be obvious that this work leans more toward accepting the optimistic view of French development than the pessimistic view; the rosy view generally fits my account of scientific and technical development better than the dark view. The glaring deficiencies of French economic development are allowed their chiaroscuro function when justified. It may be, as Trebilcock notes with satisfaction, that "the revisionist tactics for the economic history of France

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appear to be passing out of style, but "French entrepreneurial history remains a shooting war with learned articles serving as projectiles."¹¹ The historian has the luxury of waiting for the victory of one gang or another.

In spite of the argument that the Restoration was a period of great growth in industrial production, the clear dualism afflicting French technology before 1850, with the archaic far outweighing the advanced technologies, makes it dubious to posit a French industrial revolution for the period 1830–50. The general Continental practice of founding technical schools to overcome economic backwardness continued with the founding of the *Ecole centrale des arts et manufactures* in 1829 in order to promote "the creation of a new breed of men, intellectually armed with a knowledge of *la science industrielle* and morally fortified by the precepts and discipline of three years at their Parisian school."¹² From the 1830s on even the university faculties began to show signs of life. And it would not be long before they would begin to flatter the technical schools by trying to imitate them in forging as best they could some industrial connections. Technical schools may promote industry, but industry frequently looked like the source of scientific life and growth for the faculties. Later in the century some of the faculties gave birth to versions of the great Parisian technical schools, a development inconceivable without the existence of the very industry that these faculties so assiduously promoted.

Abolished in 1793, reestablished in 1808, the collection of independent faculties – letters, sciences, medicine, law – designated for linguistic convenience as French universities, showed little sign of dynamism before the Third Republic.¹³ The ten original faculties of science, to which five more were added in 1854, were small groups of professors, frequently from lycées, chiefly concerned with reproducing themselves in sufficient numbers to fill a small number of secondary school and faculty jobs. Paris was an obvious exception. Some of the greatest contemporary scientists were associated with the founding of the Sorbonne faculty of sciences. Research was not given a key role in the university system, but it did exist and grew slowly, with an important spurt in the 1830s, until the reform movement of the 1860s institutionalized and legitimized research with the founding of the *Ecole pratique des hautes études* in 1868. Devoted to the research ethos, the *Ecole pratique* was a part of Duruy's excessively ambitious reforms aiming at the promotion of a revolution in higher education, then beginning to be the victim of unfavorable comparisons with foreign exemplars. True, the *Ecole* was just an administrative mechanism for the distribution of funds, but what could be more important, especially as a beginning? Good results were soon evident in all areas of science, with a new burst of creativity in physics and the maturing of a research cycle in marine biology. Along with the rise of the

University of Paris, one must note the corresponding decline of the Muséum and, to a lesser extent, the Polytechnique and the Collège de France as centers of research. After 1937, with the arrival of Leprince-Ringuet, the Polytechnique became important again in basic research in physics. The basis for the rapid expansion of the university in the last quarter of the nineteenth century was firmly established, but the faculties needed subsidized students, money for construction and equipment, and professors interested in research as well as in teaching and service. By 1900 the provision of these ingredients by the Third Republic had produced one of the world's great university systems, a system that was particularly strong in the sciences.

In his study of the political role of French universities, George Weisz has shown the failure of higher education to live up to the expectations of politicians who wanted universities to "play a major role in fostering social integration." The faculties of science were probably the most feeble contributors to the social mission of the universities, although, as Weisz admits, even "science could not remain totally isolated from the ideological battles of the Third Republic."¹⁴ The Third Republic did not lack scientists willing to proclaim an alliance between democratic republicanism and science or to concoct the basis of an ideological marriage. The republic was not without powerful weapons in its quest for ideological support in the faculties: appointments to new chairs, the influence of the Conseil supérieur de l'instruction publique, and even the system of university inspection by Parisian professors. But it proved notoriously difficult, if not finally impossible, to squeeze much ideological sap out of science itself. Catholics and Marxists have found science equally refractory to their ideological wooing. Not only did science qua science show itself to be generally immune to the infection of political ideology, but the new science of biology was nearly as politically sterile as physics and chemistry, with all failing miserably to supply much ammunition for the republican *Kulturkampf*. No genuine fusion of ideology and science took place, even with the ostensibly promising opportunity of a meeting of biology and positivism.

Yet for a while about mid-nineteenth century it looked as if positivism and biology would form a fruitful alliance and French politics would benefit from its secular offspring. Certainly the scientifically sanitized positivism of Littré and his acolytes played a role in the Société de biologie, but even here the influence of Charles Robin must be weighed against the preponderance of Claude Bernard. That both positivism and French biology opposed evolution, especially the Darwinian variant, had little consequence in the forging of a common ideological outlook. The fact is that the ideas of Comte and even of the few medical scientists who embraced one type of positivism or another were unacceptable to most biologists and of little importance in

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the definition of research programs. As physiology emerged as the supreme biological science, at least in its own powerful opinion, the divergence between Bernard's nonphilosophy and positivism became the stumbling stone for the ideologues whining for a scientific *Weltanschauung* or a scientifically inspired *Kulturkampf*. Littré's positivism was popular with the first generation of republican politicians, who thought it to be the ideological gyro for university reform and national unity with social integration. Alas, by the 1870s it was plain that scientism of all sorts was a weak reed incapable of eliciting much intellectual support and certainly not able to sustain a national consensus.¹⁵

Considerable attention has been focused on the fortunes of French physics and on the shortcomings of organic chemistry in the nineteenth century. Little attention has been directed toward biology, except to lament the failure of French biologists to ingest Darwinism, a failure probably without much significance for research because of the generally contested status of Darwinism as a paradigm and as a research program. About 1850 the Muséum and Collège de France, whose reputation in biology was much admired in England, were much stronger scientific institutions than the faculty of sciences in Paris. But by the turn of the century the faculty was much better in biology than the Muséum and, considering the wide spectrum of biological research, more active than the Collège de France. The Collège rarely deviated from the respectability of physiological research, still an important biological area but much less so than in the heyday of Claude Bernard. The state-stimulated growth of secondary education, with its necessary fillip to faculties, and the key research role played by doctoral students go a long way toward explaining the new research dominance of the faculty of sciences in Paris.

The development of marine biology was a general Euro-American phenomenon in which France played a major research role. Here was a classic case of the interaction of national, local, university, and scientific interests, as was also the case in the growth of university institutes of applied research. And whatever we may think about the old-fashioned great-man theory of history, whose version in the history of science is now under attack by the epistemological disease of ethnomethodology, great individuals, defined as such by others as well as subtly by themselves, were conspicuous in creating this area of research.

In spite of striking success in marine biology, the general state of French biology early in the twentieth century was quite unsatisfactory for many of the biologists, especially when they compared the conceptual advances in Germany and England with the seeming stagnation in France. Even if one makes due allowance for the constitutional inclination of the French to find

that foreigners are doing it better, a century's impressive growth in biological research and teaching ended in intellectual confusion and pedagogical smugness and stodginess. The success of the research program in marine biology did not seem transferrable to other areas of biological research. The question of what direction French biology should take led to a division of leading researchers into two enemy camps with no immediate benefit to research or teaching. Beginning as a bitter academic monk's quarrel, a squabble between two of France's leading biologists soon enveloped the whole field of research, with serious questions being raised on the orientation of the major research areas and on France's ability to keep up with the work being done in other countries. One group even argued that the whole direction of research, largely derived from marine biology, was hopelessly old-fashioned. By the 1920s it was inevitable that the structure of higher education be blamed for a striking scientific failure that had been snatched from the jaws of success.

One of the most distinguishing features of the provincial faculties of science was the establishment in the late nineteenth century of institutes and programs of applied science; indeed, without these ventures in technology many of the faculties would have remained local stagnant fens with no tributaries into the mainstream of science. Victor Duruy was full of Baconian optimism in hoping that the universal exhibition of 1867 would show businessmen that the "wealth of industry flows, like a river from its source, out of the chemist's laboratory and the physicist's and naturalist's study."¹⁶ Yet the theorem worked well enough to convince governments and a few industrialists to push technology into a position of dominance in higher scientific education. After the stimulus of defeat in 1870, French private interests, in collaboration with the Ministry of Commerce, promoted the establishment of commercial and industrial schools in many of the major cities. It is not unreasonable to make a positive correlation between the growth of the French economy in at least metallurgy, chemicals, and electricity, especially in Paris, Lyon, Nancy, and Toulouse, and the rise of the university institutes and programs of applied science, which were churning out about 500 industrial degrees annually by 1913.¹⁷ With the 550 higher-level graduates of the *grandes écoles* and the 600 lower-level products of the *écoles d'arts et métiers*, France was among the few countries in the world endowed with substantial human resources over a broad spectrum of the engineering and technical needs of a great power.¹⁸

It is curious that two of the areas in which French science has had considerable success, biology and applied science in the universities, were experiencing difficulty early in the century. Nothing fails like success. Applied science became excessively vocational. Scientific research and

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industry remained in a state of hostile virginity instead of entering into a fruitful intercourse. But these deficiencies should not blind us to the "significant methodological and ideological interactions" of nineteenth-century science and technology.¹⁹ This is part of what Kuhn calls the second scientific revolution of the first half of the nineteenth century, although the interactions seem more evident in the second half of the century. The French case also raises considerable doubt as to the universal necessity of maintaining the separate institutional arrangement of "the universities for *Wissenschaft* and the Technische Hochschulen for industry and the crafts" in order to have first-rate science and technology. Across the channel were the English sisters of the French provincial universities. The civic universities of Birmingham, Liverpool, and Manchester, which owed much to their "intimate connections and interrelations with industry," were "leading centres of scientific advance" in almost all industrial areas.²⁰ A mutually beneficial parasitism seems to have prevailed between science and technology since the eighteenth century.

Agricultural research and related teaching were paltry affairs in the universities when compared with the wealth of industrially related programs. No diploma mills for agricultural studies existed in the faculties. To some extent, this was the result of the adequacy of education provided by the Ministry of Agriculture, vigilant in jealously guarding its prerogatives from imperialistic ventures of the Ministry of Education. But in ferreting out the connections between the faculties of science and agriculture one must look beyond the few formal institutes and programs producing the lowly *brevets* and certificates, for there did exist close relations between science and agriculture at theoretical and practical levels. The late nineteenth-century spin-offs from pursuing agricultural work in small faculties could be important, especially in gaining local support. Isidore Pierre at Caen could wax ecstatic: "L'étude des applications des sciences à l'agriculture a pris, dans les universités françaises, un essor dont on ne saurait trop se féliciter."²¹ Many professors recognized this and preached incessantly about the services science could render to agriculture. No one was a more insistent and powerful advocate of the virtues of commercialization and of research than Louis Grandeau, first in Nancy and then in Paris. Scientists in previously peripheral subjects like botany found in the late nineteenth century that their research was of economic value or could be made to appear so with a little effort. So plant physiology and biology attracted support for laboratories – essential status symbols as well as vital instruments for the advance of science – and various kinds of agricultural institutes and stations. The regional importance of agricultural science is clear in cases like that of Bordeaux, where industries based on wine and pine drew heavily upon

chemistry to found the Station oenologique and the Institut du pin, both offspring of the University. The structure of a national system of agricultural research was clearly visible in France by 1914.

In the short run the high-quality research network was more important for the scientific elite than for the peasantry. The peasant's republic did little for his agricultural education. The input of science into agricultural production was limited. Certainly French agriculture was a less competitive industry on the world scene than it should have been, but this probably had little to do with science. By the end of the century science had become firmly attached to the end of the agricultural chain: Consumption gave rise to thorny questions concerning quality and safety. Answers were mainly the job of the lower ranks of the scientific army, while the higher ranks often tried to keep a certain distance from the dangerous quarrels arising out of public health. The interest of a serious scientist in consumer issues is often, as a critic said of one of Barthes's intellectual flirtations, like that of a man interested in women but who can appreciate them only by an X-ray machine. The professionalization of the public health movement was dependent on the development of scientific analytical techniques and the production of personnel by the state's faculties of science.

In higher education the French state enjoyed a monopoly until 1875, when Catholics were given the right to establish faculties, and retained easy dominance after the establishment of limited freedom for private interests. In many ways the five Catholic universities came to occupy a role in France's educational system out of proportion to their educational significance, although that was considerable. A prominent role was given to the sciences in the Catholic universities, with serious attention paid to the wishes of local industrial and agricultural elites, who had to supply most of the funds for the new institutions. But Catholics, who also had access to the excellent state system, were unwilling to build the monuments of glory envisaged by the hierarchy. The new universities were also hindered by political and legal shackles as a result of coming into maturity during the rise of radical anticlericalism. Only for a while did it look as if Catholicism might be as stimulating for French capitalism as Confucianism has been for Japanese industrial success.²² While Catholic and anticlerical were caught in a sort of Barthesian clash of "organized networks of obsessions," the nation suffered, although there was inevitably some national benefit derived from the competition, however unequal, between Catholic and state institutions. Some dormant state faculties finally came alive when confronted by the threat of a Catholic faculty, and others were spurred on to greater efforts than would ever have been thought possible before 1875. The impact of Catholic higher education was far less than Catholic elementary and

secondary education, but it is a largely forgotten chapter of French history that deserves a modest rehabilitation. "Et salut, témoins purs de l'âme en ce combat/Pour l'affranchissement de la lourde nature!"²³

The pattern of professional scientific communication definitively established in the nineteenth century was clearly different from that in the humanities and most social sciences. Scientists came to publish the results of their research "in journals read only by the profession. Books are exclusively textbooks, compendia, popularizations, or philosophical reflections, and writing them is a somewhat suspect, because non-professional, activity."²⁴ Probably truer of the twentieth than of the nineteenth century, this statement nevertheless identifies a distinguishing characteristic of scientific publication that had its origins in the seventeenth century but became a striking characteristic only in the nineteenth century. Research and publication also became "unquestionably key elements in any successful academic career."²⁵ Doctoral dissertations, more original and unfortunately longer, became more important in the degree-granting process and in job getting.²⁶ The increasing loss of scientific importance for books did not mean that there were fewer published: the need for textbooks in the expanding educational system, the growing lay demand for popularizations, and the publication of the classics of science produced a great increase in books and monographs. The French developed a Gallic textbook model widely regarded, especially by the French, as superior to the pedagogical efforts of their neighbors. The publication of *Les Atomes* (1913) by Jean Perrin showed that they were not always wrong in their assumption of French superiority in continuing the Enlightenment tradition of *haute vulgarisation*. William Ramsey was conventional enough in praising Perrin's style as a product of French sensitivity that was unattainable by people of the North. J. D. Bernal was struck by another virtue of Perrin's book: The brilliant experimentalist turned publicist showed a combination of the imaginative experimental methodology with refined German mathematics, presented in its full complexity and abstraction without a sacrifice of reality and comprehensibility.²⁷ Perrin's scientific reputation was firmly established before his work of popularization, but the book gave him a more general fame and enhanced his reputation even within the scientific community, where one specialist often has to understand another's specialty through a popularization. The scientist's creative work is another matter.

Kuhn states that "the first half of the nineteenth century . . . witnessed a vast increase in the scale of the scientific enterprise, major changes in patterns of scientific organization, and a total reconstruction of scientific education." The processes accelerated in the second half of the century, especially with the growth of scientific education and research in the university system.

Scientific societies with their own journals proliferated as old disciplines became “professions with their own institutional forms,” subsidized by both governments and private interests. New fields, like physics and biology – previously “clusters of research fields” – jelled.²⁸ The transformation of science did not necessarily mean that all old priests were replaced by new presbyters, as was clear in the survival of natural history. Modern science of high quality came to be increasingly associated with the existence of a university faculty; this was nearly axiomatic in provincial France, where the faculty of sciences was inevitably the only research and teaching institution in the region, and even in Paris the faculty of sciences accelerated the professionalization of science. In the new tower of Babel, specialist spoke only to specialist, the generalist’s color was abandoned for mathematical nuance, but the tower stood firm in the advancement of knowledge.

Pas la couleur, rien que la nuance!
 Oh! la nuance seule fiancée
 Le rêve au rêve.²⁹

New laboratories and buildings, more professors and *maîtres de conférences* attended by even more laboratory technicians, an increase in the quantity and quality of research, expansion of scientific education at all levels, and publication of monographs and journals: all highly desirable, even a necessity for a powerful program in science, and all expensive, virtually unattainable without substantial and steady funding. In the last century of French scientific growth, there is a possible paradox: For most of the period, there seems to have been low-level funding by a parsimonious state and less by private interests; yet France ended up as one of the world’s few significant scientific and technological powers endowed with a powerful military technology. The simple escape from the paradox is to take the short-range view that the French science empire is of recent vintage, less than fifty years old. Certainly there is a great difference in scale between all aspects of the funding of science in the 1930s and in the 1980s. There are also important differences in the funding mechanisms of the two periods. Perhaps, in the end, the best explanation is that of sold souls. As Freeman Dyson said about the pact between Oppenheimer and Groves, the new position of science is the result of a Faustian pact between scientists and the military state.

Historians are notoriously reluctant to admit the total novelty of any major intellectual or institutional change. So one can dimly detect the origin of the science empire in the late nineteenth century and certainly clearly see it in the first three decades of the twentieth century, with a mini-Faustian pact coming into existence during the First World War, chiefly as a result of the modest mobilization of scientists and as a result of the founding of new